U.S. Patent and Trademark Office rules or to correct informalities. As required by 37 C.F.R. § 1.121(b)(3)(iii) and § 1.125(b)(2), a Marked Up Version Of The Substitute Specification comparing the Specification of record and the Substitute Specification also accompanies this Preliminary Amendment. In the Marked Up Version, double-underlining indicates added text and bracketing indicates deleted text. Approval and entry of the Substitute Specification (including Abstract) is respectfully requested.

Applicants assert that the subject matter of the present application is new, non-obvious, and useful. Prompt consideration and allowance of the application are respectfully requested.

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SYSTEM AND METHOD FOR TESTING THE LOAD[
]_OF AT LEAST ONE IP-SUPPORTED DEVICE

FIELD OF THE INVENTION
The present invention [is directed]relates to a system[, as
well as to a]_and method for testing at least one device in a
communications network that is based on an IP ([I]internet

5   protocol) standard, [in the loaded state]by one or more users.

BACKGROUND INFORMATION
Developers, system providers and administrators of large
heterogeneous network configurations based on the IP standard,

10   such as the [I]internet, [are]appear to be facing mounting
challenges due to the rapid growth of the Internet and the
speedy advancement in transmission and hardware technology.
Therefore, testing a new network or network expansions prior
to actual installation, for their load state, [is]may be

15   considered an important task. By a load test[,] one
[understands, quite generally,]may mean that the targeted
loading of the network, [particularly]such as of the routers
and servers connected to such a network, in order to determine
their performance with respect to the required data throughput

20   and the response time to a user request. There is, therefore,
a need for a test system, which is able to test network
components based on the IP standard, under real load
conditions, to be able to ensure that all network components
are functioning properly in an error-free manner, within their

25   predefined performance limits.

The [object]reference U.S. Patent No. 5,669,000 purportedly
concerns a system for remotely testing a computer system,
where instructions can be sent from a host computer 100 to so-

30   called target machines. The target machines, in turn, perform

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actions that a user would otherwise undertake.

The reference European Patent No. 0 883 271 purportedly
concerns a method as well as a system for managing data-
service systems. The test method is suited for generating test
traffic or test signals to simulate a data transmission when
subscribers access services. The test system includes test
devices which are set up as decentralized devices, which, via
a plurality of so-called measuring routes, may allow a
determination of the behavior of mutually influencing modules
or the behavior of one module in the entire system.

SUMMARY OF THE INVENTION

Exemplary embodiments and/or exemplary methods of the present
invention [is, therefore,]are directed to [devise]providing a
test system and a test method[,] which will [be able to be
adapted simply and quickly to changing IP network structures,
IP access techniques and IP communications protocols, and run
by a]enable the load of a device to be tested to be
automatically tested by a plurality of network ysers, it being
possible for the test system to be centrally operated by one
single operator.

[The present invention achieves this technical objective,
first of all, by employing the features of Claim 1.

A core idea]Further exemplary embodiments and/or exemplary
methods of the present invention [is]are directed to
[provide]providing a semi-automated test system[,] which
[is]may be able to establish a plurality of mutually
independent IP connections to a communications network based
on the IP standard, in order to run, via these connections,
mutually independent test procedures, [which]each
[correspond]corresponding to the operations of a real network
user. [In very general terms, s]Such a test system [is]may be
designed for testing at least one device, in the loaded state,

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[To this end, the test system]<u>Further exemplary embodiments</u> <u>and/or exemplary methods of the present invention are directed</u> <u>to providing a test system which</u> includes at least one programmable control device having an assigned memory device in which a plurality of session scripts may be stored, each of which contains a predefined test procedure. In all the documents, a session script [is]<u>may be</u> understood to mean the scripted simulation, in recorded form, of a real network user, who [typically]performs actions based on the IP standard[, such as]<u>. The IP standard may include</u> establishing a connection to a provider, downloading files to a server, using a web browser, and initiating [the]<u>a</u> connection. A session script may contain, for example, a user <u>identification (user</u> ID<u>)</u>, a user password, an IP destination address, for example<u>,</u> of a server connected to the communications network, the user ID and the password of such a server and the service and communications protocol utilized, such as the FTP (file transfer protocol) or the HTTP (hypertext transfer protocol). [It is important to point out that e]<u>E</u>ach session script <u>may</u> contain[s] a predefined number of operations that a real user could enter into a personal computer in order to request a specific IP service via the communications network.

[In addition,]<u>Further exemplary embodiments and/or exemplary</u> <u>methods of the present invention may involve</u> at least one session computer[is] connected to the control device. Each session computer has a plurality of mutually independent connection interfaces, via which an independent IP connection to the communications network may be established at any one time. Assigned to each connection interface, in turn, [is]<u>may</u> <u>be</u> a script-processing device, also called load-generating device in the following, which, in dependence upon a session script assigned by the control device, may establish an IP connection to a device to be tested and start the predefined

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test procedure. This [makes it possible to run]<u>can allow a running of</u> a plurality of mutually independent test sessions in automated fashion between various simulated users and <u>allow</u> one or more devices <u>to </u>connect[ed] to the communications

5   network, such as of a router or a server, without an operator having to manually carry out a session at the session computer.

[T]<u>In exemplary embodiments and/or methods of the present</u>
10   <u>invention, t</u>he complexity of the test system may be enhanced by applying the same or different session scripts to a plurality of load-generating devices of a session computer, which, in dependence upon the session script assigned in each instance by the control device, [are]<u>may</u> then<u> be</u> able to
15   establish a separate IP connection to one or a plurality of the devices to be tested and initiate the corresponding test procedure. To this end, implemented in each session computer [is]<u>may be</u> a session-management device which supplies the session script assigned by the control device to each
20   load-generating device.

[T]<u>In further exemplary embodiments and/or exemplary methods</u>
<u>of the present invention, t</u>he session computers [are]<u>may be</u> designed to support every existing network-access technology.
25   They [will]<u>can</u> be able to be readily adapted to future network-access technologies. For example, every connection interface of a session computer [may be]<u>is</u> connected to an analog and/or digital modem. [It is also practical to insert]<u>In further exemplary embodiments and/or exemplary</u>
30   <u>methods of the present invention,</u> one or more interface cards, for example<u>,</u> LAN<u> (local area network)</u> cards,<u> may be inserted</u> into the session computers, which each have a plurality of connection interfaces. [On the other hand]<u>Further,</u> each connection interface of a session computer may be assigned to
35   an analog or digital modem or be linked to [a conventional concentrator]<u>an available or data concentrator</u> to interface to

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an ATM (asynchronous transfer mode) network. As digital modems, ISDN modems or ADSL (asymmetric digital subscriber line) modems come under consideration. In this manner, a separate IP connection may be established via each connection

5   interface of a session computer.

The control device and the session computer connected thereto may either be implemented in one single machine or be connected via a backbone network.

10

To be able to log or capture or print out and later analyze the various test sequences, each session computer can ha[s]ve a memory for storing status data on each device to be tested and results and status messages from each initiated test

15   procedure. The status data of a device to be tested [are]may be considered[, in particular,] to be the data throughput from and to the device to be loaded, as well as its response time. The response time of a device [is]may be understood, in this context, to be the time that the device requires to react to a

20   specific request from a user.

[T]Exemplary embodiments and/or exemplary methods of the present invention may includes that the session computers transfer the stored status data on the tested devices and the

25   results and status messages from each active test procedure to the control device which is able to display this data on a display device assigned thereto and analyze the same. In addition, the control device may ha[s]ve a keyboard assigned to it, via which one may enter new session scripts, for

30   example, or intervene in active test procedures in order, for example, to abnormally terminate a test procedure or reset parameters. In this manner, the test system may be adapted to any hardware and software change in the communications network, merely by writing a new session script and storing it

35   in the control device.

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The communications network based on an IP standard is, for example, the Internet or any firm-specific Intranet. As devices to be tested, access routers and servers come into consideration, for example, which belong to various service
5   providers. Servers, which are based on an IP standard, are [generally known]available and[are], therefore, not discussed in detail.

[The technical objective is likewise achieved by the method
10   steps of Claim 10.

An advantageous further embodiment constitutes the subject matter of dependent Claim 11.

15   The present invention is elucidated in the following on the basis of]BRIEF DESCRIPTION OF THE DRAWING
The figure shows a test system according to an exemplary embodiment[, in conjunction with]_of the [enclosed figure]present invention.
20

DETAILED DESCRIPTION
The figure shows a test system, denoted by 10, with whose assistance,[one may test] the operability, for example, of the Internet 90, in particular of its network components, such
25   as access routers 80, or of servers 100 of various service providers connected thereto, may be tested in the loaded state. Test system 10 may also be referred to as an IP load-test system, to indicate that the test system, as well as the components to be tested with respect to their load,
30   support IP protocols. Test system 10 includes a control and service computer 20, to which a plurality of test computers, called "session computers" in the following, are connected, in the present example, via a star coupler 30 and a so-called backbone network 35. For the sake of clarity, merely three
35   session computers 40, 50 and 60 are schematically depicted, session computer 40 being shown in [greater]some detail. For

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that reason, the design of the session computers in terms of circuit technology [is principally]may be explained with respect to session computer 40.

5   Control and service computer 20 has a keyboard, by way of which an operator may generate any permissible session scripts, for example, which are subsequently stored in a memory (not shown) assigned to control and service computer 20.

10

By session script, one [understands, quite generally,]may understand the description of an automated user, who, in conjunction with a session computer, may automatically execute IP-supported operations and activities, which a real Internet

15   user could also undertake manually at a personal computer. In other words, each session script contains a defined test procedure, which may be used to simulate a typical behavior of a real Internet user at the session computers. Each session script may include[s] an initialization procedure, a test

20   procedure, as well as an end procedure. In this context, the initialization and end procedures [are]may be executed only once in each session, while the test procedure may be carried out repeatedly. In addition, the writer of the session script may include certain error and status messages which are

25   generated over the course of a running test procedure. In principle, any operations and actions at all may be utilized in a session script, as long as they are based on the IP standard. Moreover, by way of control and service computer 20, variables may also be set within a session script before the

30   test procedure is started. In this manner, generally formulated session scripts may be easily and quickly adapted to special customer requests. Other parameters, such as the number of repetitions of one test procedure and timing intervals, may likewise be defined in a session script.

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Moreover, an operator at the control and service computer 20

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may determine at which session computer(s) and via which
connection interfaces of the selected session computers, a
test procedure should be started, how many test procedures
should be started at the same time, how long a test procedure

5   lasts, or how often the same test procedure should be
repeated.

Inserted into each session computer 40, 50 and 60 [are]may be,
for example, four LAN cards 42, 52 and 62, [which, in turn,

10   ]each [have]having, for example, four separate connection
interfaces 441-44n,[also] called connection ports. To
interface with Internet 90, in the present example, each
connection interface [is]may be connected to a digital ADSL
modem 70, although such an interface connection is[only]

15   shown for connection interface 44_1. Each modem 70 may be linked
via a transmission line to an access router 80 or to various
routers. [It goes without saying that t]_Test system 10 may
also support any other access technology. Thus, instead of
ADSL modems, ISDN routers may also be connected to the

20   connection interfaces of the session computers. [It is also
conceivable to link]The connection interfaces of any one
session computer may be linked to a[generally known]n
available concentrator, which provides an access to an ATM
network. In another case, [it is possible to link]the

25   connection interfaces may be linked via a serial connection to
analog or digital modems, with whose assistance a dial-up
connection to any router and, thus, to Internet 90 may be
established. As described with reference to session computer
40, a script-processing device, in the following also named

30   load-generating device 45_1-45_n, [is]may be assigned to each
connection interface 44_1-44_n of each session computer 40, 50,
and 60, as explained in greater detail further on. It should
be noted here that the load-generating devices may also be
implemented as software modules.

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In addition, in each session computer 40, 50 and 60, a

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session-management device [is]may be provided, whose task is to supply session scripts assigned by control and service computer 20 to selected load-generating devices. With regard to session computer 40, session-management device is denoted

5   here by 46. In addition, in each session computer 40, 50, and 60, a memory may be provided in which the status data from the devices to be tested, as well as the results and status and error messages from the initiated test procedures are stored. These status data, status and error messages, and results of

10   the test procedures in question may be transferred (transmitted or copied) from each session computer to the control and service computer 20, and stored there. In addition, the control and service computer [is]may be designed to analyze the messages and results received from the session

15   computers and to graphically display the same via a monitor.

At this point, it should be noted that test system 10 may be used to test IP networks with respect to their software and hardware components from various manufacturers. [It is, thus,

20   possible to test t]The operability of routers and servers within a network based on an IP standard[,] may be tested using one single, central test system.

[A scenario is used in the following to elucidate the method

25   of functioning of t]Test system 10[.

The intention here is for test system 10] may be used to check the handling capacity of server 100 connected to Internet 90. Here, the assumption is initially made that router 80 is

30   functioning in an error-free manner, so that error messages occurring during the test procedure may be clearly attributed to server 100 to be tested.

[The]An assumption [is also]may be made, based on the

35   manufacturer's specifications, that server 100 is able to handle up to 50 users simultaneously, who, for example, want

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to download data via the FTP (file transfer) protocol. In this case, the operator at control and service computer 20 may select[s] that session script which makes it possible to automatically establish a connection to server 100 to be

5   tested, and download a dedicated file from a dedicated directory of the server. If, in the present test case, 32 queries to server 100 are simultaneously simulated, at control and service computer 32, the operator selects connection interfaces via which a test procedure should run in each

10 instance. For this, the addresses of the connection interfaces are either entered via the keyboard of control and service computer 20, or appropriate icons are clicked on at the monitor. For example, the operator may select[s] all 16 connection interfaces 44_1-44_n of session computer 40 and the

15 first eight connection interfaces of the two other session computers 50 and 60, respectively, via which a test procedure should run to server 100. Control and service computer 20 subsequently may transfer[s] the session script in question and the addresses of the selected connection interfaces to the

20 particular intended session computers. At this point, the session-management device in each session computer may assure[s] that the session script is loaded into all load-generating devices 451-45n of session computer 40, as well as into the first eight load-generating devices of

25 session computers 50 and 60, respectively. Under the control of the session script, each load-generating device may establish[es] an IP connection via the connection interface assigned to it and ADSL modem 70 connected thereto, for example via the PPPoE protocol to router 80, which may

30 assign[s] each connection interface its own IP address and a user password. After that, an identification [is]may be carried out between server 100 and the particular intended connection interface via protocol PPP. Following this initialization phase, each selected load-generating device

35 [is]may be prompted by the session script to execute the FTP IP service, which may prompt[s] the server to download the

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files in question to the selected connection interfaces. The
test procedure [is]may be subsequently terminated by each
selected or dialed load-generating device, and the connection
is released. During the individual test procedures,

5   predetermined status and error messages [are]may be logged in
the session computers to the selected connection interface
messages and, at the same time, may be routed to control and
service computer 20, to be able to monitor the running test
procedures there. Each session computer 40, 50 and 60 [is]may

10   be able to determine the data throughput, as well as the
response time of server 100. Since the average data throughput
from and to server 100, as well as the server's response time
are preset by the manufacturer, it may be determined from the
calculated data throughput and from the ascertained response

15   time, for each selected connection interface, whether server
100 has executed the 32 test procedures with or without
errors. In this manner, each Internet component may be
automatically tested by test system 10 with respect to its
required performance features, in that appropriate session

20   scripts are loaded into selected load-generating devices of
the particular intended session computers, and are executed.

Since the connection interfaces and the load-generating
devices of each session computer assigned thereto [are]may be

25   designed independently of one another, in the present example,
users, who become active independently of one another, may be
simulated using each session computer 16. [To]For all[intents
and] purposes, a single operator at control and service
computer 20 may suffice[s] in order to be able to operate a

30   test system having any number of automated users.

[Thanks to test system 10, it is possible to automatically
test]Exemplary embodiments and/or exemplary methods of test
system 10 may allow automatic testing of a device to be tested

35   to check the load produced by a plurality of network users. To
this end, it [is merely]may be only necessary for an

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appropriate session script to be written for each permissible user action, and to be stored in control and service computer 20. Any test situations at all may be simulated by loading appropriate session scripts onto selected load-generating

5   devices of the particular intended session computers 40, 50, and 60, which then, independently of one another, establish separate IP connections to the devices to be tested, and execute test procedures thereon.

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[Abstract

]

ABSTRACT OF THE DISCLOSURE

[The present invention is directed to a]A system[, as well as to] and a method for testing at least one device in a communications network based on an [IP]IP-standard ([I]internet protocol[)] standard), in the loaded state and/or for a plurality of users. [At t]The[present time, no] system[s are known which can be used to] and method may test the load state of the IP[-]-based networks in a semi[-]- automated fashion. Such a system [(10)]and method may include[s] at least one programmable control device[(20)] having an assigned memory device, in which a plurality of session scripts is able to be stored, which each contain a predefined test procedure, and at least one session computer [(40, 50, 60)]connected to the control device [(20)]and [having]has a plurality of mutually independent connection interfaces[(44_1-44_n)] for executing at least one session script. Via each connection interface, an independent IP connection to the communications network [(90) is able to]may be established. In addition, each connection interface[(44_1-44_n)] may ha[s]ve assigned to it a script-processing device[(45_1-45_n)], which, in dependence upon a session script assigned by the control device[(20)], is able to establish an IP connection to the device[(80, 100)] to be tested and initiate the test procedure.

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